

Automotive Technology 5th Edition

Chapter 79 GASOLINE DIRECT-INJECTION SYSTEMS

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain learning objectives to students as listed below: <ol style="list-style-type: none"> 1. Explain how a direct-injection fuel delivery system works. 2. Discuss a gasoline direct-injection fuel injector, its modes of operation, and the piston shapes used in the system. 3. Describe engine start systems and the port- and direct-injection systems used in Lexus vehicles. 4. Discuss how to troubleshoot a gasoline direct-injection system.
Establish the Mood or Climate	Provide a <i>WELCOME</i> , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: This lesson plan is based on the 5th Edition Chapter Images found on Jim's web site @

www.jameshalderman.com

LINK CHP 79: [ATE5 Chapter Images](#)

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1. SLIDE 1 CH79 GASOLINE DIRECT-INJECTION SYSTEMS

2. SLIDE 2 EXPLAIN Figure 79-1 A gasoline direct-injection system injects fuel under high pressure directly into the combustion chamber

Check for ADDITIONAL VIDEOS & ANIMATIONS @ <http://www.jameshalderman.com/>
WEB SITE IS CONSTANTLY UPDATED

Videos

[Direct Fuel Injection, Mechanical \(View\)](#)
[\(Download\)](#)

DISCUSSION: Have the students discuss the operation of a gasoline direct injection system. What are advantages & disadvantages of this type of injection system? Are disadvantages enough to limit its use? **FIGURE 79-1**

3. SLIDE 3 EXPLAIN Figure 79-2 engine equipped with a gasoline direct injection (GDI) sometimes requires a NO_x catalyst to meet exhaust emission standards

DISCUSSION: Review with the students what a NO_x storage catalyst is and how it functions. Why is a NO_x storage catalyst sometimes required to meet emission standards? **FIGURE 79-2**

SAFETY High-pressure fuel systems are very dangerous. High pressure fuel can penetrate skin. It also can severely injure the eyes or cause blindness.

4. SLIDE 4 EXPLAIN Figure 79-3 typical direct-injection system uses 2 pumps—one low-pressure electric pump in fuel tank and other a high-pressure pump driven by camshaft. The high pressure fuel system operates at a pressure as low as 500 PSI during light load conditions and as high as 2,900 PSI under heavy loads

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5. **SLIDE 5 EXPLAIN Figure 79-4** A typical camshaft-driven high-pressure pump used to increase fuel pressure to 2,000 PSI or higher.

DISCUSSION: Have the students talk about the **low-pressure supply pump**. How is it similar to any other fuel injection supply pump?

FIGURE 79-3 & 4

6. **SLIDE 6 EXPLAIN Figure 79-5** gasoline direct-injection (GDI) fuel rail and pump assembly with the electric pressure control valve.

DISCUSSION: Have the students discuss **Common Fuel Rail Supply System**. Why is it necessary to use this system? **FIGURE 79-5**

DISCUSSION: Ask the students to discuss the **fuel rail pressure sensor** used on direct-injection systems. Why do these systems need a pressure sensor?

DISCUSSION: Ask the students to **DISCUSS CHART 79-1**. Have them compare specifications for port fuel injectors with those for direct fuel injectors

DEMONSTRATION: Show example of a **gasoline direct fuel-injection injector**, if available. A local dealer may let you borrow a direct fuel injection injector to show to class.

DISCUSSION: Ask the students to discuss the different **modes of operation of direct fuel-injection systems**. Do they see any advantages to these different modes of operation?

7. **SLIDE 7 EXPLAIN Figure 79-6** In this design, the fuel injector is at the top of the cylinder and sprays fuel into the cavity of the piston.

8. **SLIDE 8 EXPLAIN Figure 79-7** The side injector combines with the shape of the piston to create a swirl as the piston moves up on the compression stroke.

9. **SLIDE 9 EXPLAIN Figure 79-8** The piston creates a tumbling force as the piston moves upward.

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DEMO



QUESTION



QUESTION



QUESTION



QUESTION

DEMO



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DEMONSTRATION: Show students a piston from a port fuel injected engine. Show them piston from a direct fuel-injected engine, if available, and explain the difference(s).

FIGURES 79-6, 7, 8

DISCUSSION: Ask the students to discuss piston top designs used in direct fuel-injection engines. How might a design for direct fuel-injection engine be different from that of a port-injected engine?

FIGURES 79-6, 7, 8

10. **SLIDE 10 EXPLAIN** Figure 79-9 Notice that there are conditions when the port fuel-injector located in the intake manifold, and the gasoline direct injector, located in the cylinder both operate to provide the proper air-fuel mixture

DISCUSSION: Ask students to discuss Lexus system that combines port injectors with direct injectors. What might be an advantage of this system? **FIGURE 79-9**

11. **SLIDE 11 EXPLAIN** Figure 79-10 There may become a driveability issue because the gasoline direct-injection injector is exposed to combustion carbon and fuel residue

DISCUSSION: Ask the students to discuss the engine start system used by Mitsubishi. How would they adapt to driving a vehicle equipped with this type of system?

DISCUSSION: Ask students to discuss service procedures for gasoline direct-injection systems. Why do direct-injection engines accumulate carbon buildup, especially if they are more fuel efficient?

DEMONSTRATION: Show the students' valve from an engine that has carbon buildup. Explain that this buildup, if severe enough, can restrict airflow. **FIGURE 79-10**

ON-VEHICLE NATEF TASK GASOLINE

DIRECT INJECTION Identification: Research service information, such as engine management system operation, vehicle service history, and TSBs, **(P-1) Page 248**

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[Crossword Puzzle \(Microsoft Word\) \(PDF\)](#)

[Word Search Puzzle \(Microsoft Word\) \(PDF\)](#)

